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ABSTRACT

The United States Training and Employment Service General Aptitude Test Battery (GATB), first published in 1947, has been included in a continuing program of research to validate the tests against success in many different occupations. The GATB consists of 12 tests which measure nine aptitudes: General Learning Ability; Verbal Aptitude; Numerical Aptitude; Spatial Aptitude; Form Perception; Clerical Perception; Motor Coordination; Finger Dexterity; and Manual Dexterity. The aptitude scores are standard scores with 100 as the average for the general working population, and a standard deviation of 20. Occupational norms are established in terms of minimum qualifying scores for each of the significant aptitude measures which, when combined, predict job performance. Cutting scores are set only for those aptitudes which aid in predicting the performance of the job duties of the experimental sample. The GATB norms described are appropriate only for jobs with content similar to that shown in the job description presented in this report. A description of the validation sample is included. (AG)

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June 1970

U.S. Training and Employment Service
Technical Report
S-61R

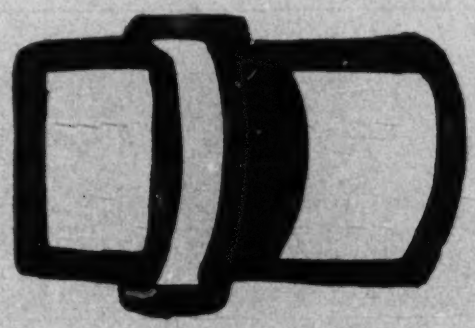
Development of USTES

APTITUDE TEST BATTERY FOR

PIPE FITTER
(const.)
862.381

PLUMBER
(const.)
862.381

U.S. DEPARTMENT OF LABOR
Manpower Administration



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Technical Report on Development of USTES Aptitude Test Battery

For . . . .

Plumber (const.) 862.381
Pipe Fitter (const.) 862.381

S-61R

(Developed in Cooperation with the
Texas State Employment Service)

U. S. Department of Labor
Manpower Administration

June 1970

FOREWORD

The United States Training and Employment Service General Aptitude Test Battery (GATB) was first published in 1947. Since that time the GATB has been included in a continuing program of research to validate the tests against success in many different occupations. Because of its extensive research base the GATB has come to be recognized as the best validated multiple aptitude test battery in existence for use in vocational guidance.

The GATB consists of 12 tests which measure 9 aptitudes: General Learning Ability, Verbal Aptitude, Numerical Aptitude, Spatial Aptitude, Form Perception, Clerical Perception, Motor Coordination, FingerDexterity, and Manual Dexterity. The aptitude scores are standard scores with 100 as theaverage for the general working population, with a standard deviation of 20.

Occupational norms are established in termsof minimum qualifying scores for each of the significantaptitude measures which, in combination predict job performance. For any given occupation, cutting scores are set only for those aptitudes which contribute to the prediction of performance of the job duties of the experimental sample. It is important to recognize that another job might have the same job title but the job content might not be similar. The GATB norms described in this report are appropriate for use only for jobs with content similar to that shown in the job description included in this report.

GATB Study # 827

Development of USTES Aptitude Test Battery

For

Plumber,(const.) 862.381-074
Pipe Fitter (const.) 862.381-042

S-61R

This report describes research undertaken for the purpose of developing General Aptitude Test Battery (GATB) norms for the occupation of Plumber (const.) 862.381-074 and Pipe Fitter (const.) 862.381-042. The following norms were established:

GATB Aptitudes	Minimum Acceptable GATB Scores
N - Numerical Ability	85
S - Spatial Ability	80
Q - Clerical Perception	75
M - Manual Dexterity	80

Research Summary-Validation Sample

Sample:

322 male workers apprenticed as Plumbers and Pipe Fitters in various cities in Texas.

This study was conducted prior to the requirement of providing minority group information. Therefore, minority group status is unknown.

Criterion:

Supervisory ratings.

Design:

Concurrent (test and criterion data were collected at approximately the same time).

Minimum aptitude requirements were determined on the basis of a job analysis and statistical analyses of aptitude mean scores, aptitude-criterion correlations and selective efficiencies.

Concurrent Validity:

Phi Coefficient = .30 ($P/2 < .0005$)

Effectiveness of Norms:

Only 67% of the nontest-selected workers used for this study were good workers; if the workers had been test-selected with the above norms, 77% would have been good workers. Thirty-three percent of the nontest-selected workers used for this studywere poor workers; if the workers had been test-selected with the above norms, only 23% would have been poor workers. The effectiveness of the norms is shown graphically in Table 1:

TABLE 1

Effectiveness of Norms

	Without Tests	With Tests
Good Workers	67%	77%
Poor Workers	33%	23%

SAMPLE DESCRIPTION

Size:

N = 322

Occupational Status:

Apprentices.

Work Setting:

Apprentices were employed in Houston, Beaumont, Dallas, Fort Worth and San Antonio, Texas.

Employer Selection Requirements:

Education: None required. High School education preferred.

Previous Experience: None required.

Tests: None used.

Other: None.

Principal Activities:

The job duties for each worker are comparable to those shown in the job description in the Appendix.

Minimum Experience:

All workers in the final sample had at least ten months job experience.

TABLE 2

StandardDeviations (SD), Ranges and Pearson Product-Moment Correlations with the Criterion (r) for Age, Education andExperience; N = 322.

	Mean	SD	Range	r
Age (years)	23.1	4.3	16-41	-.059
Education (years)	11.1	1.8	3-16	.315**
Experience (months)	31.9	16.6	10-60	.118*

*Significant at the .05 level.
**Significant at the .01 level.

EXPERIMENTAL TEST BATTERY

All 12 tests of the GATB, B-1001 were administered during February 1953 to March 1954. The B-1001 scores were converted to equivalent B-1002 scores.

CRITERION

The criterion consisted of ratings based on a combination of job performance and school achievement. These ratings were made by the Area Joint Committee of Plumbers and Pipe Fitters and the school coordinator. The rules and regulations of the State and Area Committees require the employers and the schools to furnish monthly ratings of the apprentices for review at each meeting. The schools furnished attendance marks, progress records, grades and ratings on the attitude towards the job. These complete records were reviewed and combination overall ratings were used to obtain the broad category ratings. No attempt was made to treat either the data on school work or job performance separately, since the committees felt that the two measures should be combined for criterion purposes. The committees were well acquainted with every apprentice in their respective samples. The ratings were combined by placing all of the workers who were rated in the above average group together. The same was done for the average and below average groups. This resulted in 103 people in the above average group, 114 in the average group and 205 in the below average group. For computational purposes, the ratings were converted to quantitative values of 61, 50 and 39 for the above average, average and below average groups respectively.

Criterion Dichotomy:

The criterion distribution was dichotomized into low and high groups by placing 33%of the sample in the low group to correspond with the percentage of workers considered unsatisfactory or marginal. Workers in the high criterion group were designated as "good workers" and those in the low group as "poor workers." The criterion critical score is 50.

APTITUDES CONSIDERED FOR INCLUSION IN THE NORMS

Aptitudes were selected for tryout in the norms on the basis of a qualitative analysis of job duties involved and a statistical analysis of test and criterion data. Tables 3, 4 and 5 show the results of the qualitative and statistical analyses.

TABLE 3

Qualitative Analysis
(Based on the job analysis, the aptitudes indicated appear to be important to the work performance)

Aptitudes	Rationale
G - General Learning Ability	Required in learning and understanding the reading of blueprints, specifications and applicable building codes in addition to knowing and practicing all safety codes. It is also important in order to plan work well ahead of installation so that piping work will be coordinated with other crafts.
N - Numerical Aptitude	Required in calculating length and volume of pipes. It is important to be able to measure and cut pipes to about 1/8 inch accuracy and to stub out drainage and other piping lines to 1/16 inch of absolute height in relation to finished floor level.
S - Spatial Aptitude	Required to visualize installations from blueprints, sketches and specifications and to make simple piping drawings.
P - Form Perception	Required to recognize on sight all common fittings, pipe sizes, tools and materials.
M - Manual Dexterity	Required in all phases of handling equipment and pipes safely, skillfully and accurately.

TABLE 4

Means (M), Standard Deviations (SD), Ranges and Pearson Product-Moment Correlations with the Criterion (r) for the Aptitudes of the GATB; N =322

	Mean	SD	Range	r
G- General Learning Ability	99.6	16.4	54-155	.371**
V - Verbal Aptitude	92.9	15.7	57-148	.304**
N - Numerical Aptitude	95.7	17.6	41-146	.297**
S - Spatial Aptitude	109.7	18.6	63-157	.289**
P - Form Perception	102.1	16.9	60-156	.162**
Q - Clerical Perception	91.3	14.7	51-144	.305**
K - Motor Coordination	93.7	16.5	33-138	.165**
F - Finger Dexterity	100.3	18.5	52-166	.110*
M - Manual Dexterity	107.4	18.4	57-161	.208**

*Significant at the .05 level.
**Significant at the .01 level.

TABLE 5

Summary of Qualitative and Quantitative Data

Type of Evidence	Aptitudes								
	G	V	N	S	P	Q	K	F	M
Job Analysis Data									
Important	X		X	X	X				X
Irrelevant									
Relatively High Mean				X	X				X
Relatively Low Standard Dev.									
Significant Correlation With Criterion	X	X	X	X	X	X	X	X	X
Aptitudes to be Considered for Trial Norms	G	V	N	S	P	Q	K	F	M

DERIVATION AND VALIDITY OF NORMS

Final norms were derived on the basis of the degree to which trial norms consisting of various combinations of aptitudes G, V, N, S, P, Q, K, F, and M at trial cutting scores were able to differentiate between the 67% of the sample considered to be good workers and the 33% of the sample considered to be poor workers. Trial cutting scores at five-point intervals approximately one standard deviation below the mean are tried because this will eliminate about one-third of the sample with three-aptitude norms. For four-aptitude trial norms, cutting scores of slightly less than one standard deviation below the mean will eliminate about one-third of the sample; for two-aptitude trial norms, minimum cutting scores of slightly more than one standard deviation below the mean will eliminate about one-third of the sample. The Phi Coefficient was used as a basis for comparing trial norms. Norms of N-85, S-80, Q-75 and M-80 provided optimum differentiation for the occupation of Plumber (const.) 862.381-074 and Pipe Fitter (const.) 862.381-042. The validity of these norms is shown in Table 6 and is indicated by a Phi Coefficient of .30 (statistically significant at the .0005 level).

TABLE 6

Concurrent Validity of Test Norms
N-85, S-80, Q-75 and M-80

	Nonqualifying Test Scores	Qualifying Test Scores	Total
Good Workers	46	171	217
Poor Workers	54	51	105
Total	100	222	322

Phi Coefficient = .30 Chi Square (X^2_y) = 28.8

Significance Level = $P/2 < .0005$

DETERMINATION OF OCCUPATIONAL APTITUDE PATTERN

The data for this study met the requirements for incorporating the occupation studied into OAP-37 which is shown in the 1970 edition of Section II of the Manual for the General Aptitude Test Battery. A Phi Coefficient of .19 is obtained with the OAP-37 norms of N-80, S-95, and M-85.

CHECK STUDY RESEARCH SUMMARY SHEET FOR S-61R

S-61R GATB Study #827

Plumber (const.) 862.381-074
Pipe Fitter (const.) 862.381-042

Check Study Research Summary

Sample:

89 male journeymen employed as plumbers and pipe fitters in Texas.

This study was conducted prior to the requirement of providing minority group status. Therefore, minority group composition is unknown.

TABLE 7

Means, Standard Deviations (SD), Ranges, and Pearson Product-Moment Correlations with the Criterion (r) for Age, Education, Experience, and Aptitudes of the GATB. N = 89.

	Mean	SD	Range	r
Age (years)	37.4	8.3	25-63	.184
Education (years)	10.2	2.1	4-16	.123
Experience (months)	125.7	91.4	12-504	.380**
G - General Learning Ability	96.5	16.1	51-128	.223*
V - Verbal Aptitude	94.9	16.2	56-131	.165
N - Numerical Aptitude	93.6	17.7	54-127	.230*
S - Spatial Aptitude	99.4	17.5	66-140	.024
P - Form Perception	86.0	17.1	35-127	.098
Q - Clerical Perception	84.0	16.0	52-124	.202
K - Motor Coordination	83.1	20.6	37-130	.049
F - Finger Dexterity	90.4	23.1	33-154	.041
M - Manual Dexterity	92.7	20.5	30-143	.046

*Significant at the .05 level.
**Significant at the .01 level.

Criterion:

Supervisory ratings.

Design:

Concurrent (tests and criterion data were collected at approximately the same time).

Concurrent Validity:

Phi coefficient = .25

Effectiveness of Norms:

Only 70% of the nontest-selected workers used for this study were good workers; if the workers had been test-selected with the S-61R norms, 82% would have been good workers. Thirty percent of the nontest-selected workers used for this study were poor workers; if the workers had been test-selected with the S-61R norms, only 18% would have been poor workers. The effectiveness of the norms when applied to this independent sample is shown graphically in Table 8:

TABLE 8

Effectiveness of S-61R Norms
on Check Study Sample #827

	Without Tests	With Tests
Good Workers	70%	82%
Poor Workers	30%	18%

TABLE 9
Concurrent Validity of S-61R Norms
On Check Study Sample #827

	Nonqualifying Test Scores	Qualifying Test Scores	Total
Good Workers	25	37	62
Poor Workers	19	8	27
Total	44	45	89

Phi coefficient = .25 Chi Square (X^2_y) = 5.6

Significance Level = P/2 < .01

FACT SHEET

Job Title

Plumber (const.) 862.381-074
Pipe Fitter (const.) I 862.381-042

Job Summary

Assembles, installs, and repairs pipes, fittings, and fixtures of heating, water, and drainage systems, according to specifications and plumbing codes. Lays out, fabricates, assembles, and installs piping and piping systems, fixtures, and equipment for steam, hot water, heating, cooling, lubricating and industrial processing systems, on basis of knowledge of system operation and study of building plans or working drawings.

Work Performed

Reads and interprets blueprints, building plans, and specifications to determine work aids required and sequence of installations. Locates and marks position of pipe and pipe connections, passage holes for pipe, fixtures, stacks, and meters, using tape, spirit level, and plumb bob. Cuts openings in walls and floors to accommodate pipe and pipe fittings, using handtools and power tools. Cuts pipe for water, gas, and other lines using pipe cutters, pipe-cutting machine, cutting torch, hacksaw, or hammer and chisel. Threads pipe, using threading machine. Bends pipe by hand or with pipe-bending machine.

Assembles and installs variety of metal and nonmetal pipe and pipe fittings including those made of brass, copper, lead, glass, steel, and plastic, using handtools and power tools. Joins pipe by means of threaded, calked, wiped, soldered, brazed, fused, or cemented joints. Installs drains and related flashing on roof to allow passage of vent pipes. Selects and installs specified or appropriate traps and related connections. Installs refrigeration and air-conditioning systems including compressors, pumps, meters, pneumatic and hydraulic controls, and piping. Installs special connections and equipment such as expansion joints, valves, and meters with welded, flanged, or threaded connections. Installs strainers, traps, regulating or reducing valves, and condensate lines on steam pipes.

Attaches pipe or tubing to floors, wall, framings, or ceilings, using brackets or hangers. Extends lines to designated fixtures or appliances and stubs out, using plugs or nipples, and caps. Fills pipe system with water or air and reads pressure gage to determine whether system is leaking. Sets fixtures in designated locations, installs supports, and levels fixtures, using spirit level. Installs metal escutcheons, valve handles, soap racks, shower heads, and water closets. Measures, cuts

and threads pipe and connects pipe to hot and cold outlets on water heater. Replaces washers in leaky faucets, mends burst pipes, and opens clogged drains to repair and maintain plumbing.

May lay glazed or ungalzed clay, concrete, or cast-iron pipe to form sewers, drains, and water mains.

Effectiveness of Norms

Only 67% of the nontest-selected workers used for the validation study were good workers; if the workers had been test-selected with the S-61R norms, 77% would have been good workers. 33% of the nontest-selected workers used for this study we e poor workers; if these workers had been test-selected with the S-61R norms, only 23% would have been poor workers.

Only 70% of the nontest-selected workers used in the cross-validation study were good workers; if the workers had been test-selected with the S-61R norms, 82% would have been good workers. 30% of the nontest-selected workers used for this study were poor workers; if these workers had been test-selected with the S-61R norms, only 18% would have been poor workers.

Applicability of S-61R Norms

The aptitude test battery is applicable to jobs which include a majority of duties described above.

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